



Center for Surface Engineering and Tribology (CSET)

Northwestern University and Georgia Institute of Technology

An improved understanding of wear surfaces in motion leads to superior products and processes

Center Mission and Rationale

Surface failure resulting from rubbing is a critical problem that inhibits the development of key components in advanced engines, turbines, manufacturing processes, and magnetic recording systems. In order to develop advanced components for these applications, it is necessary to understand and control basic friction, wear, and lubrication processes at the sliding interface.

Surface engineering and tribology involve the basic phenomena of surfaces in relative motion. The broad mission of the Center for Surface Engineering and Tribology (CSET) is to marshal the resources and expertise of the two universities to advance new understanding and new methods to provide new tools for developing superior products and processes in the following industries —

- Heavy Machinery
- Automotive Products
- Railroad
- Lubricants
- Agricultural and Earth Moving Equipment
- Metal Processing
- Electronic and Data Processing
- Aerospace
- Chemicals.

Research Program/Northwestern University (NU)

Research at CSET/NU encompasses five areas —

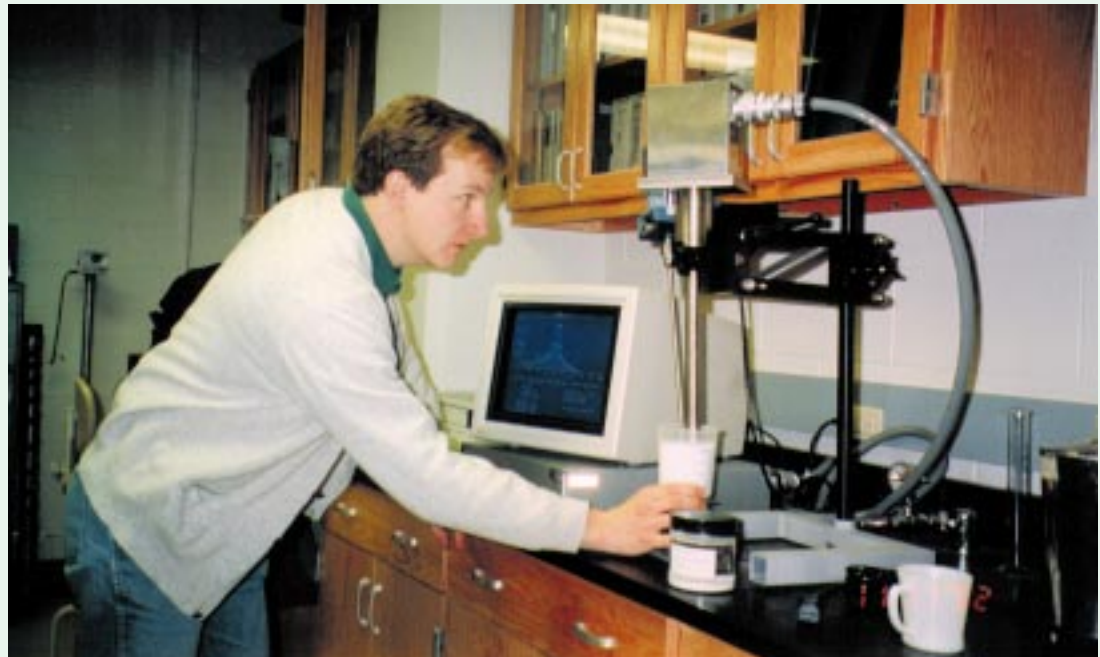
- Thin-film lubrication breakdown
- Contact fatigue phenomena
- Surface science
- Metal-working lubrication
- Ceramics, ceramic coatings, and composites.

Recent Accomplishments

The co-Center at Northwestern University has recently developed the following new concepts, methods, model, materials, and software to predict and improve tribological performance and failure in machine components and metal forming processes —

- Analytical models and software to predict sliding wear and scuffing conditions in lubricated contacts based on new concepts in microelastohydrodynamic lubrication and surface film breakdown
- Software for lubrication and failure in spur gears, connecting rod bearings, piston ring or skirt/liner contacts
- Analytical models for surface and subsurface contact fatigue life
- An efficient software to determine the subsurface residual stresses in Hertzian contacts
- Superhard carbon nitride coatings
- Analytical models and experiments of thin-film lubrication and failure in metal rolling and sheet metal forming processes.

*A National
Science
Foundation
Industry/
University
Cooperative
Research
Center
since 1985*



Experimental characterization of particle size distribution in water/oil emulsion.



Dr. Scott Bair adjusting a custom reciprocating tribosimulator.

Special Activities

- Collaborating with the Basic Industrial Engineering Laboratory (BIRL) in developing superhard coatings for tribological applications
- Collaborating with the Sensor and Actuator Center at U. Of Cal. Berkeley on microtribology.

Research Program/Georgia Institute of Technology (GIT)

Research at CSET/GIT encompasses four areas —

- Seals and bearings
- Lubricant rheology
- Friction and wear in information storage systems
- Wear of non-metallic materials.

Recent Accomplishments

The co-Center at Georgia Institute of Technology has focused on expanding

activities in modeling of lip, face, and elastomeric seals, measurements of wear in information systems, and mechanical processing of semiconductors and ceramics. The following lists specific tasks conducted within CSET —

- A model of lip seals has been developed to include elastohydrodynamic and surface tension effects.
- A model of face seals has been developed to include transient effects.



Professor Jeffrey Streater and a graduate student analyze the surface of a magnetic hard disk drive by laser interferometry.

- A simple analytical technique was developed to incorporate a realistic lubricant constitutive equation into an elastohydrodynamic inlet zone analysis, and the predictive technique has been successfully compared with experimental film thickness measurements on a non-Newtonian oil.
- Lubrication processes for hard disk drives

are being studied.

- Chemo-mechanical polishing of silicon and sapphire is being related to hydrodynamic film thicknesses.
- Optimization of dicing of silicon is being studied.

Special Activities

- A seals short course is held annually to transfer technology to industry.
- A collaboration with the Center for Integrated Diagnostics has been established to study the precursors to mechanical seal failure.



Dr. Scott Bair and graduate student Alex Baklman conducting a high pressure rheology experiment.

Center Headquarters

Co-Director: William R.D. Wilson
 219 Catalysis Bldg.
 Northwestern University
 Evanston, IL 60208
 Phone: (847) 491-3296
 Fax: (847) 467-1490
 E-mail: w-wilson@nwu.edu

Co-Director: Steven Danyluk
 GWW School of Mechanical Engineering
 Georgia Institute of Technology
 Atlanta, GA 30332-0405
 Phone: (404) 894-9100
 Fax: (404) 894-3913
 E-mail: steven.danyluk@me.gatech.edu

Center Evaluator: Eliezer Geisler
 Industrial Engineering Department
 Northwestern University
 Phone: (847) 491-7928
 Fax: (847) 491-8005